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Procedia Economics and Finance 5 (2013) 172 – 181

Procedia Economics and Finance

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International Conference on Applied Economics (ICOAE) 2013

Transformation of Scenario Planning into a Real Options Valuation in Time of Economic Transition: Latvian Case

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Abstract

The value of managerial flexibility appears to play a pivotal role nowadays, given the transition nature of Latvian economy. Overall aim of the research is to carry out Real Options Valuation (ROV) based on Scenario Planning, thereby identifying value maximizing decisions regarding the Business Unit of the Latvian Company. Having combined Scenario planning with Monte Carlo simulation and Risk-Neutral Probability-based ROV with alternative strategies of Company, authors provided a solution to the company's problem at hand. The flow chart of ROV application has been created which would be a useful "road map" for Latvian practitioners in time of economic uncertainties.

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Keywords: ***Real Option Analysis; Monte Carlo Simulation; Risk Neutral Probability Based Analysis.***

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Selection and/or peer-review under responsibility of the Organising Committee of ICOAE 2013
doi:10.1016/S2212-5671(13)00023-3

1. Introduction

The need for a sound decision-making under uncertainty has become more and more relevant due to the uneven and volatile economic climate in Latvia. According to Dye et al, 2009 company strategists should start employing more complicated techniques, which include developing very extreme scenarios. Dye at al, 2009 suggests that in the age of sailing through uncharted waters companies need to: develop strategies basing on the fact that several outcomes are possible and therefore focus on uncertainty; monitor the unfolding of events to understand which scenario is likely to come and implement one of the pre-planned strategies; to be focused on the on the long term rather than today's problems. In time of uncertainty companies need to reform their traditional approaches to Capital Budgeting (NPV; IRR) with more aggressive ones (Real Option). While businesses internationally start to adhere to ROV in their day-to-day activities, Latvian companies are seemingly lagging behind. There are few academic works on the topic, yet none of the major companies in the Latvia have publicized ROV application. However, the value of managerial flexibility appears to play a pivotal role nowadays, given the transition condition of Latvian economy. This paradigm triggered the interest of Company X (from hereinafter- the Company), the business entity focal to this research as provides a novel look on capital budgeting. The organization addressed to in the research paper is a closely-held business concern and a subsidiary of an international waste management and recycling enterprise. Established in mid 2000s, the Company provides waste collection, management and recycling services for governmental, private and corporate bodies. Owners/managers of the Company recognize that the situation in Latvia as well as in the industry it operates in provides a great potential to for ROV. Having identified several strategic alternatives it can initiate regarding one of its business units and develop several scenarios, Company managers have referred to discounted cash flow to derive result. However, it is the belief of the managers of the Company that exactly ROV could help to determine such strategy, which *would maximize the value of the business unit* in present volatile condition. The managerial problem is that though managers possess several alternatives regarding the business unit considered, it is uncertain which one in the next three years should be pursued and when. The first aim of this research paper is to provide a clear "road map" for ROV application. Second aim of the research is to carry out Real Options Valuation, thereby identifying appropriateness of application of ROV on alternative strategies for value maximizing decisions regarding the Business Unit of the Latvian Company. Because the problem area is concerned with how to frame and integrate real options into Company's scenario planning and capital-budgeting process, the unit of analysis in the study is a real option. The research is defined as descriptive in its purpose, quantitative in its approach, deductive in its logic and applied as of its outcome. Investigation of the issue is to be carried out as a co-relational field study in a non-contrived setting with minimal researcher's interference.

2. Theoretical background and research design

Scenarios as a tool of strategic planning and real options as a method of evaluation of feasibility of strategic alternatives can find broad implication for practice in many Latvian SMEs and thus can help to most managers and their needs to replace traditional approaches to strategic planning and capital budgeting with a more aggressive one on time of economic uncertainty. Real option approach can be linked into way of analyzing uncertain futures such as scenarios analysis by brining methods of strategic and financial evaluation of managerial choice on alternative strategies closer together. Real options theory originated in 1977 with the ground-breaking idea of Stewart Myers that Black- Scholes financial option pricing model developed in 1973, can be applied to capital-budgeting as well. Since the inception of the term, it has been stretched substantially. According to Luehrman, 1998 real options theory provides an effective foundation to deal with decision-making under uncertainty and high risk. The risk that there are fluctuations in the value of the underlying is expressed by the volatility factor (σ) commonly measured by standard deviation. Thurner, 2003 and Kodukula and Papudesu, 2006 argue that derivation of "trustworthy" volatility measure for the underlying is one of the basic hindrances in the valuation of real options. Although not without its criticism, logarithmic present value

approach (LPVA) is considered to be one of the best and hence – most often used real option volatility estimation techniques by opinion of Mun, 2002 and Haahtela, 2007. In LPVA value of sample standard deviation is the standard deviation of the natural logarithm of cash flow returns. This represents the volatility measure of the underlying or simply – volatility (σ). The list the mainstream ROV techniques as follows: partial differential equation (PDE), Monte Carlo Simulation (MCS) and lattices. According to Kodukula and Papudesu, 2006, Luehrman, 1995, Mun, 2002 and Damodaran, 2005 recombining binomial lattices are the most commonly used method to solve a real options problem. To derive real option value with the help of recombining binomial lattices two distinctive approaches may be applied which are based on: market-replicating portfolio (MRP) or risk-neutral probability (RNP). Most of contemporary authors like Copeland at al. 2000, Brach, 2003 and Nembhard and Aktan, 2009 resort to RNP for the analysis of a real option problem. At least two lattices are needed in RNP approach -- and more are required for compound options by Nembhard and Aktan, 2009. Firstly, the lattice of the underlying (event tree) must be constructed. Secondly, real option valuation lattice is developed and calculated in the opposite direction, back to the starting node. Damodaran, 2005 recommends for descriptive appeal both may be also merged into one lattice. According to Bailey at al., 2003, Teoh and Sheblè, 2007 once the lattice of underlying is developed for such time period, which is equal to the duration of the (longest) real option, as of the sequence presented, real option valuation lattice can be created. After lattice of the underlying has been developed a second lattice is constructed – that of real option's valuation or decision tree as recommended by Copeland at al. 2000. To make a value maximizing decision it needed to compare the value of the underlying *without* any real options with the value of the underlying *with* real options exercise. According to Mun, 2002 in the discrete time steps of the real option valuation lattice; at each one of the intermediate nodes (as well as starting node) company's management would have two alternatives: a) either exercise any of real option; b) or differ the decision. The value of the second alternative, the deferral option, varies in function to the value maximizing decision to be made in the next time step (already calculated); there for its value are determined using discounting and risk neutral probabilities. Deferral option in the real option valuation lattice is tentatively labelled as "intermediate value" (IV) by Mun, 2002 and is found using backward induction process. To determine the monetary value of managerial flexibilities or Options Value, it is necessary to subtract the value of the underlying, which, quoting by Mun, 2002 is "the static NPV without flexibility", from the calculated eNPV derived using RNP approach, where eNPV is the PV of project or company's future profitability taking into account the embedded managerial flexibilities and contingencies. According to Kodukula and Papudesu, 2006 and Mun, 2002 the general rule is that the difference between what was the underlying prior and after ROV *always* is Options Value. Thus, two research questions (RQ's) have been developed. *First research question is defined as follows: How can the managerial flexibilities Company's management has regarding its business unit be framed as real options?* The first research question is concerned with the transformation of the managerial problem into a real options problem. *Second research question is defined as follows: What decisions would maximize the value of the business unit over the next three years according to Real Options Analysis?* It will be determined how management of the Company can proactively manage real options to maximize the value of the business unit in the future. The above-stated RQ's thus are going to be addressed in the subsequent analysis. Aspects covered in the first (red) and in the second (blue) research questions are outlined in the following Flow Chart in Figure 1, whereby the general process of research is illustrated. Thus, first aim of our research paper has been reached. The flow chart of Real Option Value (ROV) application has can be a useful "road map" for Latvian practitioners in time of economic transition.

3. Scenario planning and alternative strategies.

The managerial problem addressed in this paper is that that though managers posses several alternatives regarding the business unit considered, it is uncertain which one should be pursued and when.

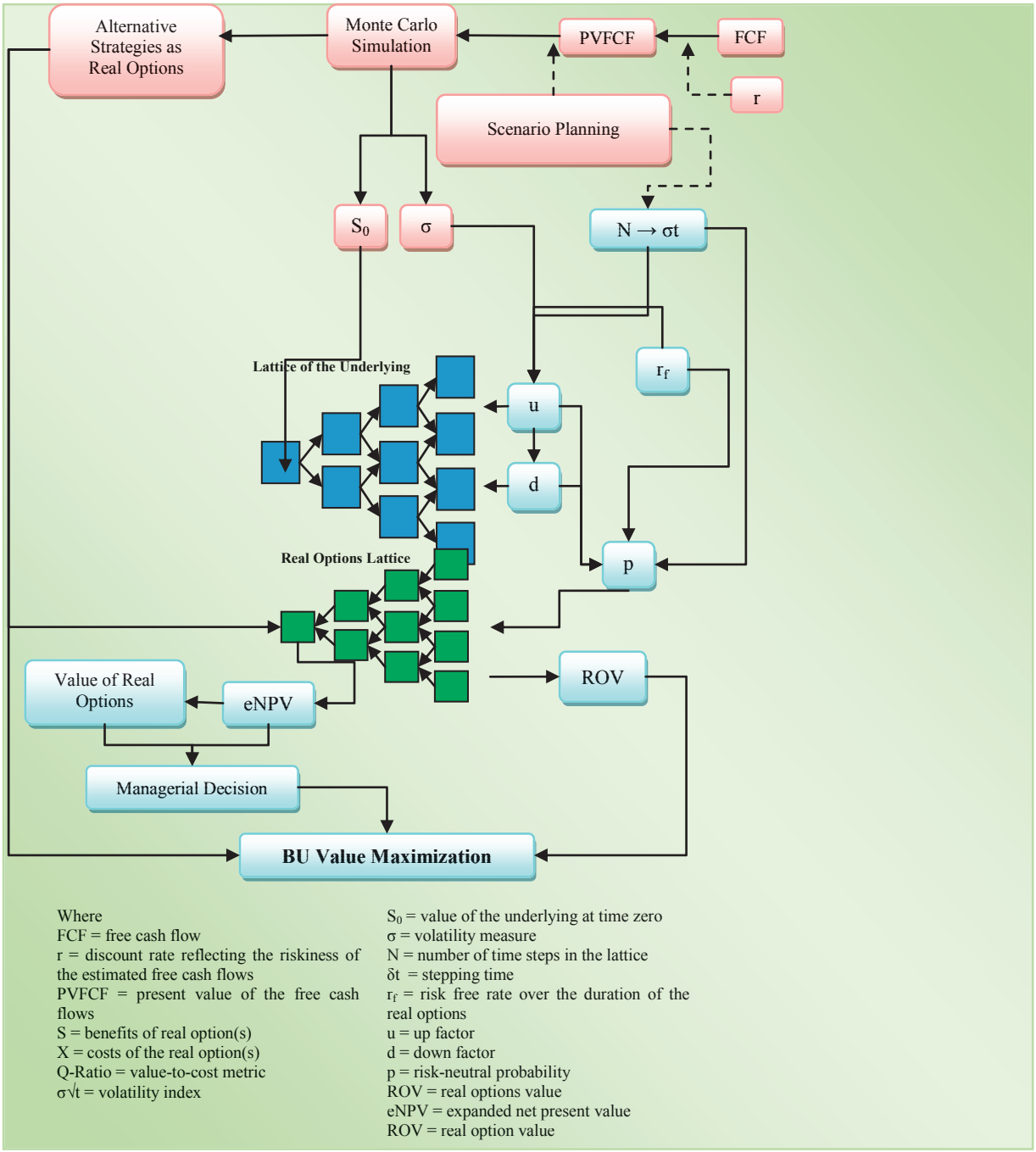

Fig.1 The flow chart of ROV application

Therefore the purpose of this research is to find a solution to the existent problem by integrating ROV into current strategic planning and capital-budgeting process of the Company's business unit, thereby providing recommendations on how to maximize its value. Therefore the whole research process is designed to provide

recommendations to the managers of the Company. Company has several ongoing business initiatives, which deal with waste collection, recycling, transportation and hazardous waste management -- each having its own clientele and management team.

Each business unit of the Company serves a different niche market both domestically and abroad. Managers of the company have made strategic planning regarding the activity of one of their main business units (hereafter – BU). At the same time the management feels that due to the uncertain condition of Latvian economy, it becomes necessary to hedge risks and make the strategy pertaining to this BU more robust. For that reason Company's management would like to integrate ROV in strategic planning process, thereby identifying what flexibilities the managers of the BU possess. Thus ROV to be conducted shall deal with this individual BU of the Company. It is the policy of the owners of the business to formulate major strategic moves on a five year basis; leaving the mid-term tactical implementation to the managers of individual business units. Last major strategy revision took place approximately two years prior – on spring of 2009. Therefore, the time frame in which all calculations shall be made is three years; after that the analysis is likely to become invalid due to pending revisions in the strategy of the concern. Owing to possible competitive pressures due to potentially sensitive information being revealed to the public Company's management wishes for the enterprise to remain unidentifiable. In effect, Free Cash Flow (FCF) value derivations and basis of other classified financial data, such as the rationale of discount rate and exact nature of the scenarios is not illustrated. Due to the requirements from the Company's liaisons, an abridged endpoint data is presented in this paper. Nevertheless, all figures prerequisite for complete ROV are shown in detail; these include FCF forecasts, benefits/costs of real options, discount rate and the scenarios considered. To fulfil the specific aims of the study, primary data is obtained from individuals, namely Company's representatives. During several unstructured face-to-face interviews the peculiars of the problem on hand and nearly all input data necessary for ROV shall be provided. In opposition, secondary sources of data adhered to in this paper constitute those sources external and internal to the organization. Finally, during the analytical process, the data will be measured via absolute scales (i.e. differences, margins, etc.) and relative scales (i.e. ratios). BU forecasted FCF's for the next three years of operations as of 1 May 2011 (using end-of-year convention and ending 1 May 2014 are depicted as follows: in 1 year 299500 LVL (1LVL=0, 7028 Euro), in 2 year 396900 LVL and in 3 year 567000 LVL. The management of the Company identified two other far less deterministic Scenarios – tentatively labelled as Slump Scenario and Recovery Scenario as well as three strategic moves it may initiate regarding the BU over the next three years, depending on the situation in the market: to expand its business; secondly, to reduce the fixed costs and thirdly to liquidate the assets. Therefore management of the Company identified two other far less deterministic scenarios – tentatively labelled as Slump and Recovery. To begin with, Company's management has a grim outlook and believes that it is approximately 35% probable that the next three years of operations are going to worse than the current one, which would result in actual FCF's to fall well below expectations. It is estimated that in the most detrimental case, the sum of forecasted FCF's would plummet in range of 25% till 40% within the next three years (Slump scenario). Contrastingly, executives also consider that the possibility that new clients shall be attracted in response to recovery of Latvian economy is far less, amounting to 15% only. Recovery scenario however could add 10% till 20% to the sum of the forecasted FCF's in the same period as the Slump scenario. The annual risk-discount rate, representing the risk of the BU and applied by the Company in its financial analysis is 13%. The Company has on hand a financial forecast for the next three years of the operations of the BU. However, Company's management feels that due to the situation in the Latvian economy these forecasts should be complemented with additional analysis. For that reason the Company has identified three strategic moves it may initiate regarding the BU over the next three years, depending on the situation in the market. Firstly, it can make additional investments to expand its business; secondly, it can contract its operations to reduce the fixed costs and thirdly – in utmost case it can abandon the BU and liquidate the assets. The management of the BU did not identify any value lost if the decision regarding either initiative is postponed for three years. While managers of the Company recognize that there is no way of telling upfront which alternative is the most financially-sound

(i.e. value maximizing); and neither it can be determined when the strategy should be initiated (i.e. investment timing), they feel that ROV could provide answers to these questions. *First alternative strategy is "Grow and Build: Market Development"*. The Company currently operates in regions near Riga. However, the managers of the Company have identified other regions, wherein operations may turn out to be profitable. On the basis of analysis conducted by Company's financial management, provision of services in additional regions would expand BU current operations by ¼. However, such expansion would cost additional 145 00 LVL for the Company, due to the expenditures related with personnel, truck servicing, gas, storage, etc. *Second alternative strategy is "Hold and Maintain: Retrenchment"*. Approximately 15% of services the BU provides generates only nominal profit (and losses at some instances), however purveying of such services is sustained regardless in fear of losing market share to competitors. The Company can discontinue these services and scale down its operations thus reducing operating expenditures and saving 150 000 LVL. These savings then could be spent on enhancing marketing activities or streamlining of logistics to offset the competitiveness lost. Nonetheless, such move would mean that 15% of the sum of FCF's is forfeited. *Third alternative strategy is"Harvest and Divest: Liquidation"*. While the Company is a privately-owned enterprise, it is a part of international chain of waste management companies. Continuing the existing operations in Latvia is of relevance to the owners of the business, but current volatile economic conditions require that an alternative to abandon the BU is to be considered. In case if the demand for services provided by the BU drops or operating expenses rocket (result in a flop of FCF's), the owners of the business shall abandon the business and salvage the assets. Being a daughter company of an international concern, the Company can freely sell its assets to other subsidiaries in Europe at a pre-specified rate. The sales price of Company's assets adjusted for any contractual penalties incurred is considered as the liquidation value of the BU. The estimated salvage value of the BU is thus set as 550 000 LVL by the managers of the business. Though liquidation of the BU shall require the consent of from the owners, BU management feels that it is necessary to include such alternative in the analysis. Since real estate would remain in Company's possession, the business may be restarted in indefinite future. *Fourth alternative strategy is "No Change Strategy"* that means carrying on current operations as usual.

4. Result of research

Based on discussions with Company's liaisons, it is determined that the Company essentially has up to three years to implement either one of the strategic alternatives it possesses regarding the BU. Since the decision to (dis)invest can be postponed, the Company has a deferral (alternatively: postponement, suspension or timing) option. Due to the already tight budgetary constraints, Company's management states that it is unlikely that it will spend additional money to obtain new information/data faster, such as carry out marketing research, probe the market, etc. Therefore it may be surmised that in this instance (absence of active spending on Company's part) deferral option parallels learning option. In three consecutive years the Company has four broad strategic alternatives: *expand the business, contract the business, abandon the business or continue the business as usual*. The last alternative – continuation as usual entails *the deferral option*, whereby the decision is postponed for some period. At the same time the first three alternatives can be collectively labelled as *a chooser option* (also could be viewed as a switching option). Until spring of 2014, the Company has two real options – option to choose and option to defer. At maturity (i.e. after three years) only the chooser option will be left, thus the Company can either expand, contract, abandon or let all real options expire worthless. *At maturity the deferral option would become nonexistent, since the decision to invest or disinvest can no longer be delayed*. In order to provide an answer to the first research question, firstly in is necessary to view all alternative strategies the Company has regarding the BU considered through the lens of real options theory. At any time in the next three years the Company can choose either one of the three mutually exclusive options: a) *expansion option* – expand the operations of the BU by servicing new geographical regions at a cost of 145 000 LVL which would augment the FCF's generated by the BU by 25% (alternatively could be labelled as growth or investment option); b) *contraction option* – shrink the operations of the BU by ceasing to provide the least profitable

services, thereby gaining 150 000 LVL but loosing 15% of FCF stream generated by the BU (alternatively: scale down or scope down option); c) *abandonment option* – liquidate the assets of the BU by selling them to another subsidiary of the parent company at 550 000 LVL (alternatively: exit or disinvestment option). Scenarios with higher probability undoubtedly are more likely to occur (i.e 50% for Base; 35% for Slump and 15% for Recovery). Prior to conducting MCS, all managerial assumptions must be accounted for and interrelations between them expressed with equations. Firstly, Base scenario is considered, then Slump and Recovery scenarios are accommodated for MCS. After conducting MCS the resulting value of the underlying and volatility factor can be obtained. For the cumulative probability set to be used in conjunction MS Excel formulae, Slump scenario should be given $0 \leq p < 0{,}35$ range; Base scenario $0{,}35 \leq p < 0{,}85$ and Recovery scenario $0{,}85 \leq p < 1$. MCS is iteratively re-run 30 times and the simulated values of both S_0 and σ are noted. Afterwards arithmetic mean of these both sets is determined. Following the MCS sequence outlined, the following values are obtained: value of the underlying at time zero ($\mathbf{S_0}$) equals **880 183 LVL**; volatility factor (σ) over the duration of real options amounts to **21,28%**. The results ROV formulas for expansion option (EOV), contraction option (COV) and abandonment option (AOV) are depicted in the proceeding Tables 1.

Table 1. Real Options Value Formula of alternative strategies

Alternative strategies as Real Options	ROV Formula
Expansion Option	$\mathrm{EOV} = \mathrm{S} - \mathrm{X} = 0{,}25 \times \mathrm{S}_{0_{i,j}} - 145\,000\ (\mathrm{LVL})$
Contraction Option	$\mathrm{COV} = \mathrm{S} - \mathrm{X} = 150000 - 0{,}15 \times \mathrm{S}_{0_{i,j}} (\mathrm{LVL})$
Abandonment Option	$\mathrm{AOV} = \mathrm{S} - \mathrm{X} = 550000 - \mathrm{S}_{0_{i,j}} (\mathrm{LVL})$

Thus, first research question has been answered. Having answered first research question, as alluded to above in this paper ROV shall be conducted by applying RNP approach answering *second research question*. Based on the managerial assumptions and MCS, PV of the underlying (S_0 = 880 183 LVL) and volatility (σ = 21,28%) is already determined. The last parameter to be identified thus is the risk free rate over real options duration - the fixed interest earned on a (last issued) three year bond is 5,875%. Calculations alongside resulting values of each of the binomial lattice parameters are specified in the proceeding Table 2.

Table 2. Recombining Binomial Lattice Parameters

Parameter of the Lattice	Formula and Value
Stepping time of binomial lattice	$\delta t = \frac{t}{N} = \frac{3}{6} = 0{,}5\ \mathrm{years}$
The up factor of binomial lattice	$u = e^{\sigma\sqrt{\Delta T}} = e^{21{,}28\%\sqrt{0{,}5}} = 1{,}1624$
The down factor of binomial lattice	$d = \frac{1}{u} = \frac{1}{1{,}1624} = 0{,}8603$
Continuously compounded risk free rate over duration of real options	$r_f = \ln(1 + r_d) = \ln(1 + 5{,}875\%) = 5{,}4370\ \%$
Risk-neutral probability	$p = \frac{e^{r\Delta T} - d}{u - d} = \frac{e^{5{,}4370\ \%\times 0{,}5} - 0{,}8603}{1{,}1624 - 0{,}8603} = 0{,}5537$

As there are six time steps in the lattice, each time step between sequential nodes will represent ½ of a year or 6 months. Starting with the simulated PV of the underlying at time zero (S_0), the lattice can be developed. In the first time step S_0 is multiplied by up factor and down factor, thus creating two sequential nodes– S_0u and S_0d. The value of each of these two nodes represents the values which the underlying may take in one time step in the RNP approach. Subsequently, such bifurcation process is repeated at each node for five consecutive time steps, thus creating a lattice with six time steps. Lattice of the underlying essentially shows how the underlying can evolve in the next three years. Taking the value of the underlying at each node, ROV can be calculated and the value maximizing decision can be identified at that node. Identification of value maximizing decisions shall start from the terminal nodes and then the tree is "rolled back". At the terminal nodes Company management can choose to continue the business as usual or alternatively – one of the real options can be exercised. Because after three years real options have reached its maturity, deferral option has no value – i.e. management *must* make a decision. It can be noted that Company can expand, contract or abandon -- with each option having its unique costs and benefits. Adhering to the mentioned data, EOV, COV and AOV at each of the terminal nodes can be calculated using formulae indicated in Table 2. Subsequently the values of all real options are compared at each terminal node and the real option, having the highest ROV is identified. Having identified the value maximizing decisions at all terminal nodes, the value of each node can be calculated. Via backwards induction real options valuation lattice is "rolled back" on time step at a time. Accordingly, calculations begin at time step 5 and are made backwards the starting node. At any time before real options' maturity (i.e. prior to the last time step) the Company can not only expand, contract or abandon the BU, but also defer (postpone) decision. Therefore the Deferral Option (fourth alternative strategy) should be taken into account in the calculations. For instance, the value of deferral option (i.e. the intermediate value) at the node "P" (IV_P) thus can be calculated according to Mun, 2002 as show in Equation (1) of Value of Deferral Option at Node "P" adapted from Mun, 2002 (slight differences due to rounding).

(1)

$$IV_P = [(\mathrm{p})\mathrm{up} + (1 - \mathrm{p})\mathrm{down}]\mathrm{e}^{-\mathrm{r_f}\delta\mathrm{t}} =$$

$$= [0{,}5537 \times 2569147 + (1 - 0{,}5537)1863707]\mathrm{e}^{-5{,}4370\% \times 0{,}5} =$$

$$\cong 2193824\ (\mathrm{LVL})$$

Where
p = risk-neutral probability
up = value of up node (i.e. the value of node "V")
down = value of down node (i.e. the value of node "W")
e = mathematical constant of exponential function
r_f = three year risk free rate
δt = stepping time.

Following the calculations of all lattice parameters, ROV by applying RNP approach can be conducted. Initially lattice of the underlying is constructed and afterwards – real options valuation lattice. Taking the value of the underlying at each node, ROV can be calculated and the value maximizing decision can be identified at that node. Identification of value maximizing decisions shall start from the terminal nodes and then the tree is "rolled back". At any node, the value maximizing decision is to be determined by weighting the value of the underlying *without* real options' exercise (or deferring the decision) against *with* real options' exercise. The real options valuation lattice is presented in the subsequent Figure 2, thereby having the following legend: each node is characterized by three rows; in the top row of each node is the arbitrary assigned denotation; the middle row represents the value maximizing decision (in LVL) at that particular node; the bottom row indicates which decision leads to value maximization at that particular node. The value of the starting node, determined via backwards induction, is calculated as **989 701 LVL**. This figure represents eNPV or the total value of the BU, taking into consideration the identified real options, *if* value maximizing decisions shall be made at all instances.

It is possible to determine the monetary value of the flexibilities Company's management has. From the equation above it can be determined that if managers would indeed make value maximizing decisions over the next three years, it augments the value of the *BU by 109 518 LVL or 12,44%* ([eNPV-NPV]/NPV). The results of Real Options Analysis using risk-neutral probabilities during the analysis of *second research question* indicate that the value of the BU the next three years is maximized if the decision currently is *deferred*. Finally, Sensitivity analysis is performed on eNPV or the total value of the BU whereby the major factors of ROV is altered in +/- 10%, one at the time. Sensitivity analysis points out that the underlying and expansion option predominantly affect the expanded value of the BU over the next three years which is calculated as *989 701 LVL*. At the starting node (i.e. node "A") it is determined that *the value maximizing decision as of present moment is to defer decision (or stated alternatively – postpone any (dis)investment)*. This entails that the Company currently should nor expand, nor contract, nor abandon the BU. Then Figure 2 below also illustrates that the optimal strategy for the Company [according to RNP approach] is to postpone decision for at least 2 years (i.e. the 4th time step). This is so since the value of the underlying shall not drop or increase as much before that time, to bring any real option so deep-in-the-money, that it instantly becomes valuable to exercise.

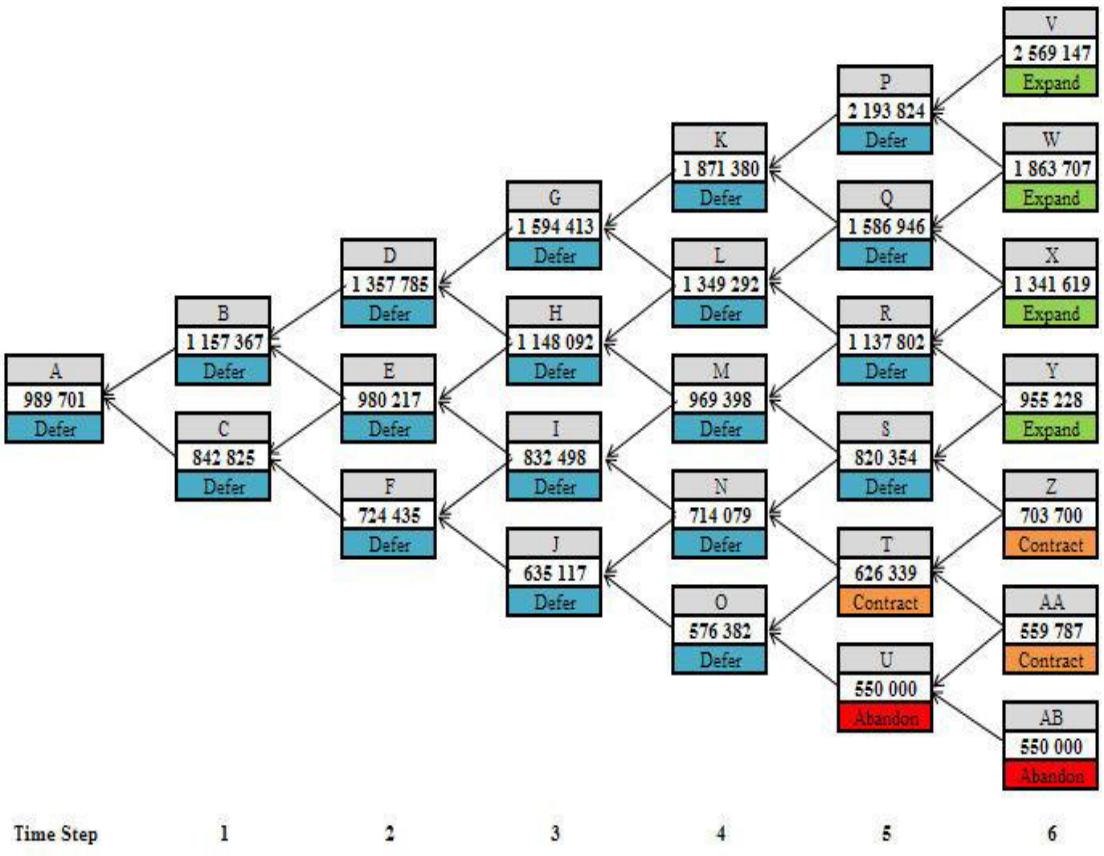

Fig.2 Real Option Valuation Lattice of alternative strategies.

5. Discussion, conclusion and future work

The major aim of this research was to carry out Real Options Analysis, thereby identifying value maximizing decisions regarding the business unit of the Company over the next three years. The aim has been

reached answering on two research questions. It viewed the strategic alternatives available to the Company regarding the business unit consider through the lens of real options theory. Company has embedded scenario planning into Monte Carlo simulation. MCS results reveal that most objective estimate of the value of the business unit over the next three years is 880 183 LVL and uncertainty associated with it – 21,28%. Then the analytical processed carried out regarding first research question indicate that Company has four alternative strategies and thus four proprietary real options as concerns the business unit discussed: expansion option, contraction option, abandonment option and deferral option. Accordingly, the proceeding conclusions can be drawn: Value maximizing decisions over real options' duration can be determined using risk-neutral probabilities in the given case, as the characteristics of real options permitted its application. The results of Real Options Analysis using risk-neutral probabilities during the analysis of second research question indicate that the *value of the business unit over the next three years is maximized if the decision currently is deferred*. The monetary value of managerial flexibility (real option value) is 109 518 LVL, if Company's management would make value maximizing decisions regarding its business unit at all instances. The abovementioned figure augments the value of the business unit over the next three years by 12, 44%. The study conducted may be continued in a number of directions, whereby problem analysis can be made more robust by referring to: compound and sequential compound options; non-recombining and/or multinomial lattices Fuzzy Pay-Off Method for Real Options Valuation.

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